

Horizontal System

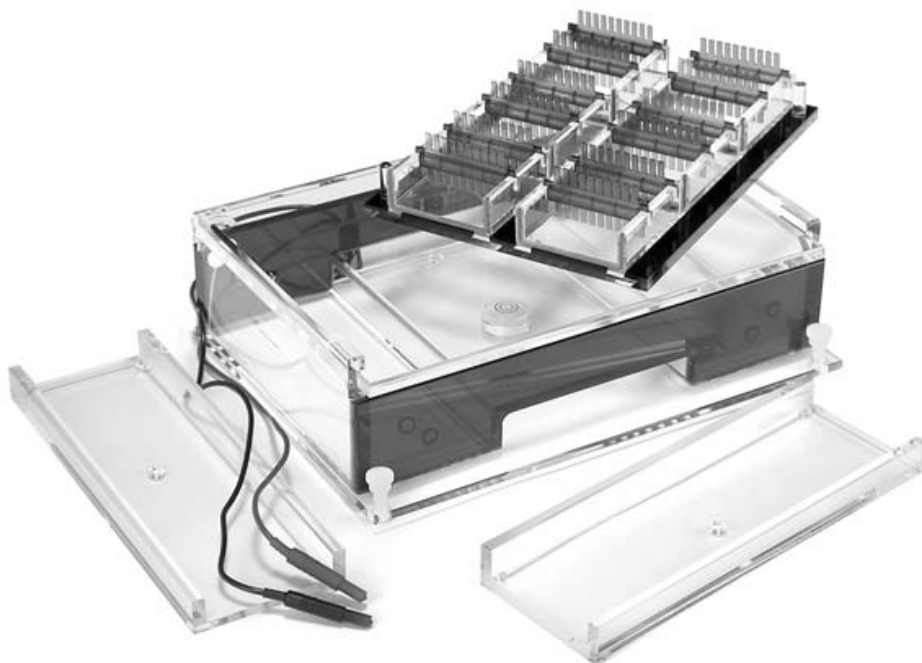
Model A2-OK

Operating and Maintenance Manual 7219011 Rev. 0



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**MANUAL NUMBER 7219011**

0	--	4/13/12	Transfer to Marietta (was 11/2002)	ccs
REV	ECR/ECN	DATE	DESCRIPTION	By



Important Read this instruction manual. Failure to read, understand and follow the instructions in this manual may result in damage to the unit, injury to operating personnel, and poor equipment performance. ▲

Caution All internal adjustments and maintenance must be performed by qualified service personnel. ▲

Warning To avoid the risk of personal shock, always disconnect the gel box from the power supply. Further, the power supply must be equipped with a shut-down-on-disconnect circuit. Do not move the unit unless the power source to the unit has been disconnected. ▲

Statement of Proper Use: Use this product only for its intended purpose as described in this manual. Do not use this product if the power leads are damaged or if any of its surfaces are cracked.

Warning Running conditions for this unit should not exceed the name plate readings found on the lower buffer chamber. ▲

This Owl System is designed to meet IEC 1010-1 safety standards (IEC 1010-1 is an internationally accepted electrical safety standard for laboratory instruments).

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Important operating and/or maintenance instructions. Read the accompanying text carefully.



Potential electrical hazards. Only qualified persons should perform procedures associated with this symbol.



Equipment being maintained or serviced must be turned off and locked off to prevent possible injury.



Hot surface(s) present which may cause burns to unprotected skin, or to materials which may be damaged by elevated temperatures.



Marking of electrical and electronic equipment, which applies to electrical and electronic equipment falling under the Directive 2002/96/EC (WEEE) and the equipment that has been put on the market after 13 August 2005.



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- ✓ Always use the proper protective equipment (clothing, gloves, goggles, etc.)
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- ✓ Always follow good hygiene practices.
- ✓ Each individual is responsible for his or her own safety.

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When more extensive service is necessary, we will assist you with direct factory trained technicians or a qualified service organization for on-the-spot repair. If your service need is covered by the warranty, we will arrange for the unit to be repaired at our expense and to your satisfaction.

Regardless of your needs, our professional telephone technicians are available to assist you Monday through Friday from 8:00 a.m. to 6:00 p.m. Eastern Time. Please contact us by telephone or fax. If you wish to write, our mailing address is:

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Section 1 General Information

The Opossum Multiple Gel system is ideal for teaching labs or labs that need to run multiple gels simultaneously. Up to six minigels (7cmW x 8cmL) can be run on this versatile system. Along with optional combs the Opossum can screen up to 144 samples at once (120 with supplied combs). EasyCast casting design allows the casting of gels without tape or plugs. UV transmissible gel trays may be placed directly on the transilluminator for photodocumentation.

Before starting, unpack the unit and inventory your order. If any parts are missing, contact Technical Services immediately.

Reference the order or catalog number on your invoice and check the corresponding parts list.

Table 1-1. Parts List

Buffer Chamber

Combs 10 well comb, Double Sided, 1.0/1.5mm Thick (12)

Super Safe Lid with attached power supply leads

Multiple Gel Caster (2)

Gel Tray Holder

UV Transmissible gel trays (6)

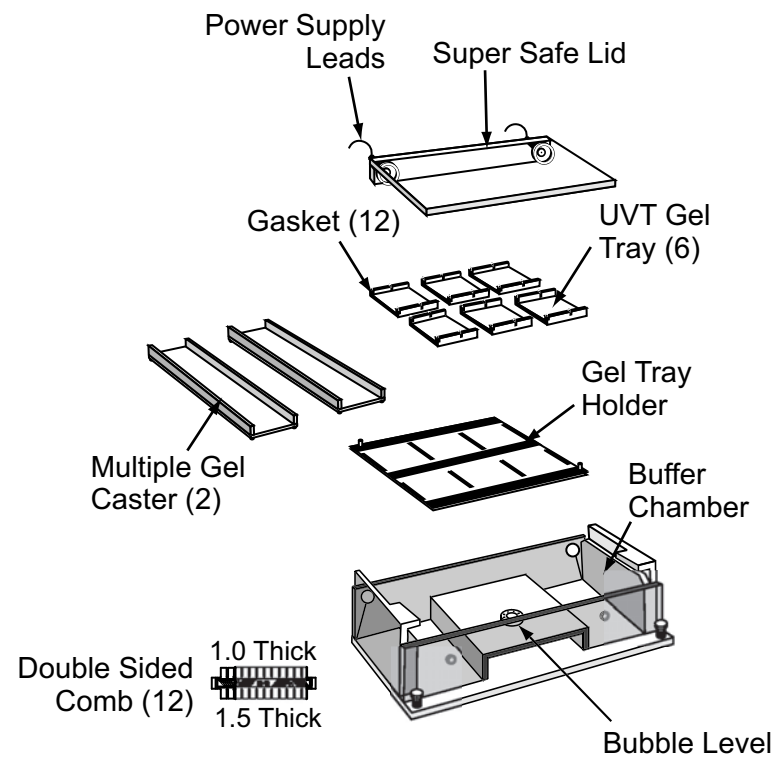


Figure 1-1. Exploded Parts Diagram

Table 1-1. Specifications

Gel size	.7cmW x 8cmL
Running Buffer	Volume 2.3L
Footprint	.28cm W x 37.5cm L x 10cm H

Section 2 Setting Up

1. For shipping and convenient storage, the gel tray is packaged inside the unit with the gasketed end gates in position upon arrival. Lift the casting tray out of the buffer chamber.

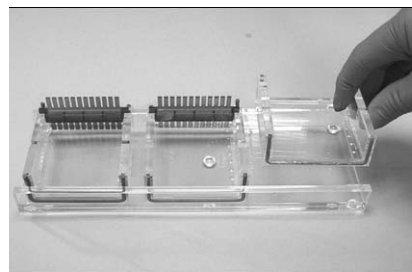


Figure 2-1. Casting Tray

2. To cast gels, place the gel tray(s) into the external multiple gel caster. The gasketed sides of the UVT gel tray form a leak proof seal along the side of the gel caster.

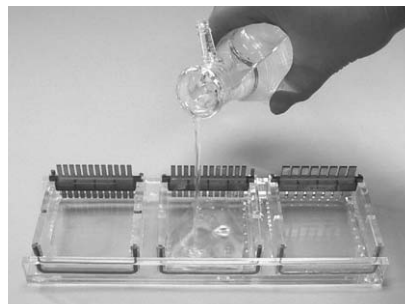


Figure 2-2. Pour Agarose

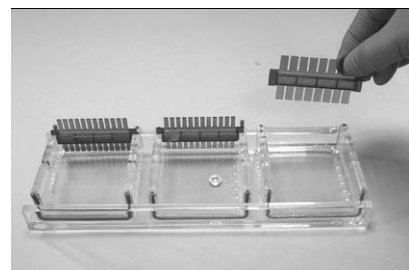


Figure 2-3. Place Combs

4. Once the gel has solidified, place the UVT gel tray (s) into the gel tray holder.
5. Level the casting chamber using the thumbscrews on each side of the unit by slowly turning one thumbscrew at a time and lining up the bubble in the level with the center circle. Place the gel tray holder in the buffer chamber, add buffer, remove combs, load samples and run the gel.

Preparing the gel - Using electrophoresis-grade agarose and compatible electrophoresis buffer the gel may be prepared in various ways. The percentage of agarose and the electrophoretic buffer used is determined by the size of the samples to be separated and further recovery of the samples. The agarose and buffer are mixed and heated over a heat source, in a microwave oven, or in an autoclave until the agarose is completely dissolved. The prepared gel then must be cooled to below 60° before casting to avoid warping the UVT gel tray due to excessive heat. If numerous gels are to be run in one day, a large volume of gel may be prepared and placed in a covered bottle stored between 40°-60° in a water bath. This provides a ready gel supply in a warm liquid form that will solidify quickly when gels are cast.

Pour or pipet warm agarose (<60°). Immediately after pouring, insert the desired comb or combs into the comb slots to form the sample wells. If only a small portion of gel is required for proper sample separation, multiple combs may be used to run 1 or 2 sets of equal distance samples simultaneously expanding the number of samples per gel that may be run. Repeat for up to 6 gels (3 per external multiple gel caster).

Section 3 Using the System

1. Once the gel (s) is completely solidified, lift the gel tray (s) out of the external gel caster. Place the gel tray (s) onto the gel tray holder. Place the gel tray holder in the buffer chamber in the running position. The running position exposes the open ends of the agarose to the buffer. Standard agarose should solidify completely in about 30 minutes.

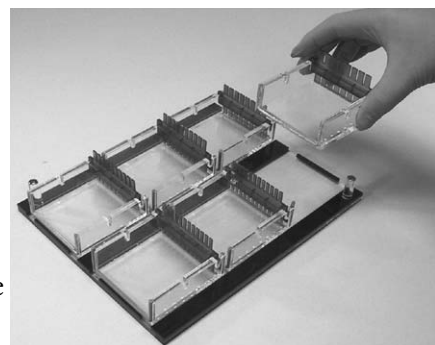


Figure 3-1. Place Gel Tray

2. Pour enough compatible running buffer into the unit to fill the chamber and completely cover and submerge the gel. Correct buffer level is clearly marked on the units side wall as “FILL LINE”. See Recommended Running Conditions for approximate buffer volumes needed for your unit. Too little buffer may cause the gel(s) to dry out during the run, while excess buffer may decrease DNA mobility and cause band distortion.

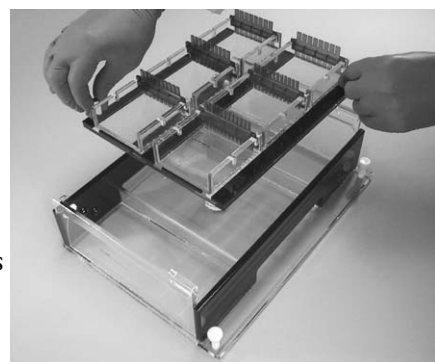


Figure 3-2. Place Gel Tray Holder

3. Carefully remove the comb (or combs) by tapping lightly to loosen, and slowly lifting straight up out of the gel tray to avoid damage to the wells.

Section 3

Using the System

4. Load prepared samples into the wells. Samples should be mixed with a sample loading buffer; giving weight to the samples so that they drop evenly into the wells and containing tracking dyes to monitor the gel run. After the gel solidifies, remove the gel tray from the external casting tray and place the tray on the lab bench. Carefully remove the sample combs by tapping and lifting straight up. Samples mixed with loading buffer that does not contain dye may be easier to load dry, especially in larger gel units to avoid cross contamination. After loading all sample lanes, place the gel tray into the gel tray holder in the running position with the gel edges facing out toward the buffer chambers and slowly fill as described in Step #2. It is wise to always run a sample lane of a known “standard ladder” to determine concentration and size of separated fragments after the gel run, and to aid in photo documentation and analysis.

Note It is sometimes easier to load the sample wells dry before placing the gel tray into the running position.

5. Carefully slide the Supersafe lid with attached power supply leads onto the unit. This will connect the power cords to the banana plug electrodes and complete the circuit. Plug other end of the power cords into appropriate power supply.
6. Turn on power supply (see Recommended Running Conditions). Carefully monitor the gel run to avoid samples running into the path of another set of samples.

Section 4 Finishing Up

1. When the gel run is complete and tracking dye has migrated as far through the gel as desired, or to the end of the gel, turn off the power supply and slide off the lid to disconnect from the power source. Carefully remove the tray (s) containing the gel (wear gloves if ethidium bromide is present). The UV Transmissible (UVT) gel tray makes visualization and photography with a UV light source easy without the need to remove the gel from the tray.
2. The gel box should be rinsed under warm running water after each use, including the UVT gel tray (s). Rinsing the UVT gel tray (s) will avoid salt build up in the gasket material from the electrophoretic running buffer, extending the gasket life and ensuring leak-free gel casting. An RNase/DNase decontaminate may be used. This electrophoresis system must never be autoclaved, baked, or microwaved!

Specifications and Recommended Running Conditions

Gel Size:7cmW x 8cmL

Buffer Capacity:2.3L

There are various types of agarose commercially available that may be used. Besides standard ultra pure electrophoresis grade agarose, there are also numerous low melting point products for easy sample recovery, as well as speciality products formulated for specific uses to separate/recover very small or very large fragments etc. To visualize and photograph the samples after the gel run for a permanent record, the gel may be stained during or following the run with a variety of stains. The most common stain for DNA is ethidium bromide. Ethidium bromide may be added directly to the gel and running buffer to quickly and easily visualize and photograph the separated fragments following the gel run without the need for additional staining. If this is not added, then following the gel run the gel may also be soaked in a concentrated ethidium bromide solution and rinsed for the same visualization. The ethidium bromide is added to the gel (after heating) and the electrophoresis buffer at a concentration of 0.5ug/ml.

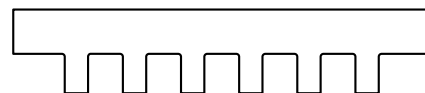
Warning Ethidium bromide is a potential carcinogen. Care in handling the powder and stock solution must be taken. Always wear gloves when handling the powder, solutions and all gels that contain any amount of ethidium bromide. ▲

Section 5 Technical Tips

Combs

Standard

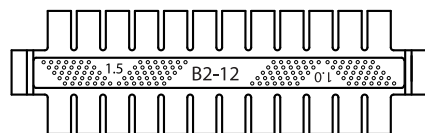
- 1.0mm (C) and 1.5mm (D) thickness for all models.



Standard

Double Sided

- Double Sided Molded Combs combine 1.0mm and 1.5mm tooth thickness on one comb.



Double Sided

Preparative

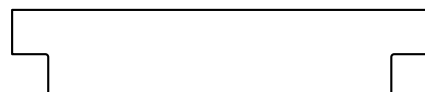
- One long well and one marker lane.



Preparative

Wall Comb

- See page 33 for details.



Wall Comb

Multi-Load Comb

- F or use with 8 channel pipet.



Multi Load Comb

Custom Combs

Call Technical Services for more information.

Reagent Information

Chart A

Mobility range of DNA in different percentage agarose gels

Agarose % (w/v)Approximate range of separated DNA fragments (kb)

0.360 to 5
0.530 to 1
0.712 to 0.8
1.010 to 0.5
1.27 to 0.3
1.54 to 0.2
2.03 to 0.1
3.0<0.1

It should be noted, an increased agarose % gives better separation of small fragments and also bands very close together that tend to be more difficult to separate, visualize and photograph. A specialty agarose product formulated to increase resolution of low molecular mass samples may also be used.

Example: A good mid-range gel percentage would be 0.7%, or 0.7g. agarose in 100mls. electrophoresis buffer (TBE or TAE), following heating and dissolving the agarose, 10ul of ethidium bromide stock solution (5mg/ml) is added. The gel would be run with compatible electrophoretic running buffer (1X TBE or 1X TAE) that also contained ethidium bromide. 1 liter of the running buffer would contain 100ul of this 5mg/ml ethidium bromide stock solution.

Chart B

Preparation & Properties of TAE and TBE Electrophoresis Buffer Systems:

These buffers are used because they both have a basic pH which gives the phosphate group of the DNA a net negative charge allowing migration of the DNA toward the positive anode in the electrophoresis chamber.

TAE - Tris acetate with EDTA (40mM Tris base 40mM acetic acid, 1mM EDTA)

<u>50X stock solution, pH 8.5:</u>	<u>1X working solution:</u>
------------------------------------	-----------------------------

242 g. Tris base	40 mM Tris acetate
------------------	--------------------

57.1 ml. glacial acetic acid	1 mM EDTA
------------------------------	-----------

18.61 g. Na EDTA “ 2H₂O (MW 372.24)

Distilled H₂O to 1 liter final volume

TBE - Tris borate with EDTA (89mM Tris base, 89mM boric acid, 2mM EDTA)

<u>10X stock solution:</u>	<u>1X working solution:</u>
----------------------------	-----------------------------

108 g Tris base	89 mM Tris base
-----------------	-----------------

55 g boric acid	89 mM boric acid
-----------------	------------------

7.44g Na ₂ EDTA “ 2H ₂ O (MW 372.24)	2 mM EDTA
--	-----------

(or 40 ml 0.5 M EDTA, pH 8.0)

Distilled H₂O to 1 liter final volume

Do not adjust pH

Buffer:	Suggested Uses and Comments:
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TAE Buffer	Use when DNA is to be recovered. For electrophoresis of large (>20kb) DNA Applications requiring high resolution. Has low ionic strength and low buffering capacity - recirculation may be necessary for long runs (> 4hrs).
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TBE Buffer	For electrophoresis of small (<1kb) DNA. Better resolution of small (<1kb) DNA. Decreased DNA mobility. High ionic strength and high buffering capacity - no recirculation needed for extended run times.
------------	---

TBE buffer reacts with the agarose making smaller pores and a tighter matrix. This reduces broadening of the DNA bands for sharper resolution.

Ethidium Bromide -

Ethidium bromide is ideal for the fluorometric detection of nucleic acids in gel electrophoresis. The addition of ethidium bromide to both the prepared gel and running buffer is a convenient way to monitor separation and keep a photographic log of gel runs. Ethidium Bromide is prepared as 10mg/ml in distilled water and used as a stock working solution of 5.0ug/ml in the electrophoresis buffer and gel. Mix ethidium bromide powder or tablet thoroughly into solution checking for any precipitate and store at room temperature protected from light.

Chart C

Amount of Agarose to prepare:

All approximate well volumes given in the chart below are based on a gel of 0.5cm thickness. Gel volume is determined by the following formula and may be adjusted according to need or preference:

$$\text{gel width(cm)} \times \text{gel length (cm)} \times \text{gel thickness (cm)} = \text{ml of agarose}$$

Unit	Agarose Volume in ml per gel thickness in cm.				
Model #	Gel size(cm)	0.25cm	0.5cm	0.75cm	1.0cm
A2-OK					

Agarose Gel Loading Buffer

Samples are prepared and combine with gel loading buffer before applying to the prepared gel. Sample buffer usually contains similar components to the running buffer, dyes for visibility, and glycerol to provide some weight to the samples. This increased sample density and color allows easy visualization of the samples and ensures samples load evenly into the wells and do not float out during loading. Dyes also migrate toward the anode end of the electrophoresis chamber at predictable rates allowing the gel run to be monitored.

The most commonly used loading buffer is glycerol, bromophenol blue, and xylene cyanol.

Section 6 Troubleshooting

Problem	Solution
Agarose leaks into chamber when casting the gel	Check to see if the gasket is correctly seated in groove and even all the way around. Remove gasket and reseal by smoothing out gently with your thumb from one end to the other. Gasket material may have a tendency to absorb salts from the running buffer. After each use, rinse the end gates under warm running water to bring back spongelike consistence of the gasket material. Gaskets may eventually become brittle with frequent use. Contact Technical Services to purchase replacement gaskets.
Bands seem to be running at an angle.	Check to be sure that the unit is properly leveled for casting and running the gel by using the thumbscrews on the base. Thumbscrews should be adjusted until the bubble in the level lines up with the levels center circle. Always center the gel tray holder on the platform and cool the agarose to below 60° before pouring to avoid warping the UVT gel tray (s).
Samples seem to be running unevenly in certain areas.	Check that the platinum electrode wire is intact running flat and evenly across the outer corners and up the side to the junction of the banana plug area. This problem could also be caused by regular casting with very hot agarose gel (>60°) which may damage the gel tray over time. Always cool the melted agarose to below 60o before casting to avoid warping the UVT gel tray (s). Warping the UVT gel tray will cause all subsequent gels to be cast unevenly.
Samples do not band sharply and appear diffuse in the gel.	Gels should be no more than 5mm thick and allowed to solidify completely before running. For standard agarose, this would be about 30 minutes, if low melting point agarose is used, it may be necessary to completely solidify gels at a cooler temperature in the refrigerator or cold room. Gels should be submerged in 3-5mm of buffer to avoid gel dry out, but excess buffer >5mm can cause decreased DNA mobility and band distortion.

Problem	Solution
Bands are not sharp, clear, and even.	Always follow the proper procedure for preparing the agarose product according to the manufacturers instructions. When preparing the agarose, be sure all the agarose powder is in solution before heating. In general, add powdered agarose to distilled water and swirl to mix. Make sure all the powder is equally wet to ensure proper melting. Heat in a microwave oven, boiling water bath, or hot plate with occasional swirling to melt and mix completely. Cool agarose liquid to below 60° and cast. Note: Gel should be cast no thicker than 5mm to avoid fuzzy banding. High percentage gels may thicken and solidify rapidly and should be cast while still a liquid.
Samples are not moving as expected through the gel, remaining in the wells, or diffusing into the gel.	Check that a complete power circuit is achieved between the unit and the power supply. Platinum wire and banana plugs should be intact. To test, simply fill the unit with running buffer and attach to the power supply without a gel or gel tray in the unit. The platinum wires on both sides of the unit should produce small bubbles as the current passes through. If a complete circuit does not exist, there will be few to no bubbles. Contact Technical Services to schedule a repair.
When the comb is removed from the gel, some sample wells are ripped and damaged.	Always make sure to allow the gel to solidify completely before moving the gel tray, unit, or removing the comb. To avoid damage to the sample wells, gently rock the comb back and forth lightly to loosen, then slowly pull the comb straight up out of the gel tray. This rocking helps to avoid suction as the comb is removed. Alternatively, once casting is complete, simply submerging the gel with running buffer will help loosen the comb. Using a higher percentage of agarose that forms a tighter gel matrix may remedy this problem as well.
The gel seems to run slower under the usual running conditions.	The volume of running buffer used to submerge the gel should only be between 3-5mm over the gel surface. Gel should be completely submerged to avoid the gel from drying out, which can smear the bands and possibly melt the gel(s) due to overheating. If excessive running buffer is added, the mobility of the DNA decreases and band distortion may result. Excess buffer causes heat to build up and buffer condensation inside the unit may result.

Additional Sources for Reference

Maniatis T., E. F. Fritsch and J. Sambrook. **Molecular Cloning: A Laboratory Manual**, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.

Short Protocols in Molecular Biology, - A Compendium of Methods from Current Protocols in Molecular Biology, Edited by Fredrick M. Ausubel, et. al.

Adams, D., and R. Ogden, **Electrophoresis in Agarose and Acrylamide Gels, Methods in Enzymology**, Vol. 152 (1987) Academic Press, Inc.

Fotador, U.. **Simultaneous Use of Standard and Low-Melting Agarose for the Separation and Isolation of DNA by Electrophoresis**, BioTechniques, Vol. 10, No. 2, (1991)

Boots, S. **Gel Electrophoresis of DNA** ; Analytical Chemistry, Vol. 61, No. 8, April 15, 1989

Section 7 Care and Cleaning

Caution Organic solvents cause acrylic to “craze” or crack. Clean all acrylic systems with warm water and a mild detergent. Do not use ethanol or other organic solvents to clean these products. Do not autoclave, bake, or microwave your unit. Temperatures over 50°C can damage the acrylic. ▲

Note If an RNase free electrophoresis system is desired, there are various methods to rid the system of RNA contamination. For fast and easy decontamination, use RNase Away®*. Spray, wipe or soak labware with RNase Away then wipe or rinse the surface clean; it instantly eliminates RNase. RNase Away eliminates the old methods that include treatment with 0.1% Diethyl Pyrocarbonate (DEPC) treated water and soaking in diluted bleach. This electrophoresis system should never be autoclaved, baked, or placed in a microwave.

Warning DEPC is suspected to be a carcinogen and should be handled with care. ▲

To order RNase Away®, contact Technical Services:

Part Number	Description
7000	.250ml bottle
7002	.475ml spray bottle
7003	1 liter bottle
7005	4 liter bottle

**Rnase Away® is a registered trademark of Molecular BioProducts*

Section 7

Care and Cleaning

Care of Acrylic

The following chemical compatibility chart is supplied for the convenience of our customers. Although acrylic is compatible with most solvents and solutions found in the biochemical laboratory, some solvents can cause substantial damage. Keep this chart handy to avoid harm to your apparatus by the use of an inappropriate solvent.

Codes:

S—Safe (No effect, except possibly some staining)

A—Attacked (Slight attack by, or absorption of, the liquid)

(Slight crazing or swelling, but acrylic has retained most of its strength)

U—Unsatisfactory (Softened, swollen, slowly dissolved)

D—Dissolved (In seven days, or less)

Table 5-1. Chemical Compatibility for Acrylic-Based Products

Chemical	Code	Chemical	Code	Chemical	Code
Acetic acid (5%)	S	Ethyl alcohol (50%)	A	Naptha	S
Acetic acid (Glacial)	D	Ethyl alcohol (95%)	U	Nitric acid (10%)	S
Acetic Anhydride	A	Ethylene dichloride	D	Nitric acid (40%)	A
Acetone	D	Ethylene glycol	S	Nitric acid concentrate	U
Ammonia	S	2-Ethylhexyl Sebacate	S	Oleic acid	S
Ammonium Chloride (saturated)	S	Formaldehyde (40%)	S	Olive oil	S
Ammonium Hydroxide (10%)	S	Gasoline, regular, leaded	S	Phenol 5% solution	U
Hydroxide (10%)	S	Glycerine Heptane (commercial grade)	S	Soap solution (Ivory)	S
Ammonium Hydroxide concentrate	S	Hexane	S	Sodium carbonate (2%)	S
Aniline	D	Hydrochloric acid (10%)	S	Sodium carbonate (20%)	S
Benzene	D	Hydrochloric acid concentrate	S	Sodium chloride (10%)	S
Butyl Acetate	D	Hydro uoric acid (40%)	U	Sodium hydroxide (1%)	S
Calcium chloride (saturated)	S	Hydrogen peroxide (3% solution)	S	Sodium hydroxide (10%)	S
Carbon tetrachloride	U	Hydrogen peroxide (28% solution)	U	Sodium hydroxide (60%)	S
Chloroform	D	Isooctane	S	Sodium hydrochlorite (5%)	S
Chromic acid (40%)	U	Isopropyl alcohol (100%)	A	Sulfuric acid (3%)	S
Citric acid (10%)	S	Kerosene (no. 2 fuel oil)	S	Sulfuric acid (30%)	S
Cottonseed oil (edible)	S	Lacquer thinner	D	Sulfuric acid concentrate	U
Detergent Solution (Heavy Duty)	S	Methyl alcohol (50%)	A	Toluene	D
Diesel oil	S	Methyl alcohol (100%)	U	Trichloroethylene	D
Diethyl ether	U	Methyl Ethyl Ketone	U	Turpentine	S
Dimethyl formamide	U	Methylene chloride	D	Water (distilled)	S
Diocetyl phthalate	A	Mineral oil (white)	S	Xylene	D
Ethyl acetate	D				

This list does not include all possible chemical incompatibilities and safe compounds. Acrylic products should be cleaned with warm water, a mild detergent such as Alconox™, and can also be exposed to a mild bleach solution (10:1). In addition, RNase removal products are also safe for acrylic. Contact Technical Services with any questions.

Section 8 Optional Equipment

Leveling Platform

The three point leveling platform, Model B-LP, ensures a flat casting and running surface. the platform is 46cm x 36cm and is large enough to fit most applications. One bubble level (BBL-1) is included.



Contact Technical Services to order replacement parts.

Table 8-2. Replacement Parts

Cat. No.	Description
PSL-5	Power Supply Leads
B1A-UVT	Gasketed UVT gel tray
B1A-CST	Multiple Gel Caster
A2-OT	Gel Tray Holder
B1A-GK	Replacement Gaskets (1 pair)

Combs

Catalog #	# of teeth	Tooth Width (mm)	Thickness (mm)
B1A-5C	5	11	1.0
B1A-5D	5	11	1.5
B1A-6	6	9	1.5/1.0
B1A-8	8	6	1.5 /1.0
B1A-10	10	5	1.5 /1.0
B1A-12	12	3.5	1.5 /1.0
B1A-PREP	2	57/4.8	

THERMO FISHER SCIENTIFIC OWL PRODUCTS WARRANTY USA

The Warranty Period starts two weeks from the date your equipment is shipped from our facility. This allows shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner.

During the first thirty-six (36) months, component parts proven to be non-conforming in material or workmanship will be replaced at Thermo's expense, including labor. Installation, calibration and certification is not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to performance of any repairs. Expendable items, glass, filters and gaskets are excluded from this warranty.

Replacement or repair of component parts or equipment under this warranty shall not extend the warranty to either the equipment or to the component part beyond the original warranty period. The Technical Services Department must give prior approval for return of any component or equipment. At Thermo's option, all non-conforming parts must be returned to Thermo postage paid and replacement parts are shipped FOB destination.

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Your local Thermo Sales Office is ready to help with comprehensive site preparation information before your equipment arrives. Printed instruction manuals carefully detail equipment installation, operation and preventive maintenance.

If equipment service is required, please call your Technical Services Department at 1-800-438-4851 (USA and Canada) or 1-740-373-4763. We're ready to answer your questions on equipment warranty, operation, maintenance, service, and special applications. Outside the USA, contract your local distributor for warranty information.



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The Warranty Period starts two months from the date your equipment is shipped from our facility. This allows shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner.

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Thermo Fisher Scientific
401 Millcreek Road
Marietta, Ohio 45750
United States

www.thermofisher.com

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